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A COMPARISON OF GARGLE CALLS OF BLACK-CAPPED CHICKADEES RECORDED IN THE LABORATORY AND IN THE FIELD

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ABSTRACT.—We compared recordings of the 'gargle' vocalization of Black-capped Chickadees (*Poecile atricapillus*) made in the field to recordings made in the laboratory of captive birds from the same populations. Individuals have repertoires of gargle calls, some of which are shared with conspecifics. Thus, a population sample of recordings reveals a variety of distinct gargle calls constituting the population repertoire. Captive birds were individually stimulated to vocalize by viewing their own image in a mirror. In the field, gargle calls were recorded during natural social interactions. We questioned whether the field recordings might reveal a greater variety of gargle calls than we found in the laboratory samples. We found that none of 901 field recorded gargle calls differed from those recorded from captive birds. *Received 22 June 1999, accepted 18 Oct. 1999.*

In our studies of the vocalizations of Black-capped Chickadees (*Poecile atricapillus*), we analyzed tape recordings of birds housed in sound-proof chambers in which an individual was stimulated to vocalize by viewing its image in a mirror (Censky and Ficken 1982, Baker et al. 1991). The call of interest is the gargle call, which, in nature, is given year-round primarily in close range agonistic interactions (Ficken et al. 1987) such as occur in contests over food. Each individual has a repertoire of gargle types, many of which are shared with others in the population, forming population dialects (Ficken et al. 1987; Miyasato and Baker 1999; Baker, Howard and Sweet, unpubl. data).

The question we address is whether field recordings reveal gargle call types that our laboratory assay does not. The laboratory assay has the advantage of allowing us efficiently to obtain large samples of gargle calls from marked individuals, characterize individual repertoires extensively, make detailed population comparisons, and recapture and re-record known individuals over time.

Field recording has the advantage of sampling a wide variety of social circumstances that could elicit gargle calls whose structures differ from those we found in the laboratory. Field recording of gargle calls, however, has severe limitations because, unlike recording of the advertisement songs of many territorial songbirds, chickadees for most of the year move about in small, dispersed flocks covering large home ranges, change locations often, and emit gargle calls infrequently. One can follow a flock for several hours and hear no gargle calls. Individuals may move from tree to tree when producing gargle calls, the identity of the calling bird is often not apparent (gargle calls can be emitted with no accompanying visual display), and the birds are frequently behind vegetation and hidden from the observer. Others have noted the difficulties in obtaining field samples of gargle calls of sufficient quality and quantity from marked birds (Hailman and Griswold 1996).

METHODS

Study areas.—Black-capped Chickadees were studied from October 1996 through March 1997 (hereafter the 1996–1997 season) and from October 1997 through March 1998 (hereafter the 1997–1998 season) at two sites in Fort Collins, Colorado. One site was northwest of Fort Collins at Lee Martinez Park (LMP) and the second site was southeast of Fort Collins at the Environmental Learning Center (ELC), about 8.5 km from Lee Martinez Park. Both sites are riparian habitat and connected by a continuous corridor of vegetation along the Cache La Poudre River.

Laboratory recordings.—Birds were trapped in Potter traps baited with sunflower seeds, transported to a laboratory at Colorado State University, placed in individual cages, and tape recorded in anechoic sound proof chambers (Industrial Acoustics Co.). In each chamber, small mirrors were located outside the cage and faced one end of each of the two perches. Recordings were made with a Uher 4200 Report Stereo IC recorder at tape speed 9.5 cm/s and a Uher M517 microphone placed midway between the two mirrors. After recording, the birds were banded and released at the site of capture. In this way, we made high quality

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recordings of many gargle calls in a few hours, and a number of individuals have been re-recorded several times, often over periods of several years. An analysis of these laboratory recordings will be presented elsewhere (Baker, Howard and Sweet, unpubl. data).

Field recordings.—Birds were recorded in the field in the areas covered by the trap sites at Lee Martinez Park and the Environmental Learning Center during the same two seasons of laboratory recordings. Gargle calls were recorded with a Marantz PMD 201 cassette recorder at tape speed 4.8 cm/s and a Sennheiser MD402 microphone mounted in a 60 cm parabolic reflector. At Lee Maretinez Park, 21 recording hours were distributed over 11 days in the 1996–1997 season, and 15 recording hours were distributed over 9 days in the 1997–1998 season. At the Environmental Learning Center, 7 recording hours were distributed over 5 days in the 1996–1997 season, and 27 recording hours were distributed over 22 days in the 1997–1998 season.

Analysis of recordings.—Audio tapes of recordings made in the laboratory and field were examined on a Kay Elemetrics DSP model 5500 sonagraph and printed on a Kay Elemetrics model 5510 gray-scale printer. Sonagraph settings were: frequency range DC–8 kHz (sampling rate 20,480 Hz), flat shaping, transform size 300 Hz (100 points), Hamming analysis window, and no averaging. In a typical bout of vocalizing, a bird repeats the same gargle call a number of times before switching to a different gargle call in its repertoire. For the laboratory recordings, we made sonograms of each different gargle call of each bird. Two or more birds from a recording site often shared some of their gargle calls, and some gargle calls were shared with more distant populations. Laboratory recordings of the gargle calls of different birds were independently classified into gargle groups by two observers (M.C.B. and T. M. Howard). Each gargle group, therefore, contained similar gargle calls from two or more birds.

We classified each call based on its component syllables. Syllables were examined visually on sonograms of gargle calls, each different syllable was given a unique number, and a syllable catalog was constructed from the laboratory recordings (Baker, Howard and Sweet, unpubl. data). Such syllable catalogs have been published for two other populations (Ficken et al. 1984, Hailman and Griswold 1996). Usually a syllable is formed of a single continuous trace (note) on a sonogram and is separated in time from other syllables. Sometimes a syllable is formed from a complex of notes that are never produced in isolation but always occur as a complex. Syllables are stereotyped in their frequency and time characteristics and readily recognized from one sonogram to another. Thus, each gargle call can be described as a series of numbers corresponding to the sequence of its constituent syllables. The gargle calls recorded in the field were thus compared to the gargle calls recorded in the laboratory by two independent observers (C.E.M. and M.C.B.) with an inter-observer agreement of 96%.

RESULTS

Although many of the field recordings were noisy or too faint to allow comparison of detailed acoustic features to our set of laboratory recordings, we nevertheless were able to identify most of the noisy or low amplitude gargle calls as equivalent to laboratory recorded gargle calls. We could do this because syllables are sufficiently stereotyped, and differences between types of syllables distinct enough, to identify syllables and the sequential structure of gargle calls even when they were somewhat degraded. Examples of a high quality field recorded gargle call, a low quality field recorded gargle call of the same group, and the laboratory-recorded equivalent gargle call are illustrated in Fig. 1. Those field recorded gargle calls that we could not compare with confidence because of even lower recording quality (66 out of 967 gargle calls) were not included in the analyses.

In both seasons, more gargle calls were recorded and more gargle groups identified in the laboratory recordings than were recorded and identified in the field data (Table 1). Although we know the exact number of individuals from which laboratory recordings were obtained, we do not know how many different birds contributed to the field recordings. For the field data, we assumed that we obtained a random sample of each population's gargle repertoire. Our assumption of randomness was impossible to verify, but the infrequency of gargle calls, the short bursts in which they usually occurred, and the number of days and hours spent in the populations during the recording effort led us to feel that sampling was broadly representative. A previous analysis suggests that sampling the repertoires of 5–9 birds provides a fairly complete sample of the gargle types in a population (Miyasato and Baker 1999).

The primary question we examined was whether the field recordings revealed any new kinds of gargle calls not found in the laboratory recordings. All 901 field-recorded gargle calls had equivalent gargle call types in the laboratory recordings. We also investigated the fine structure of individual syllables and made comparisons between gargle calls recorded in the laboratory and the field. To accomplish this, we ignored lower quality

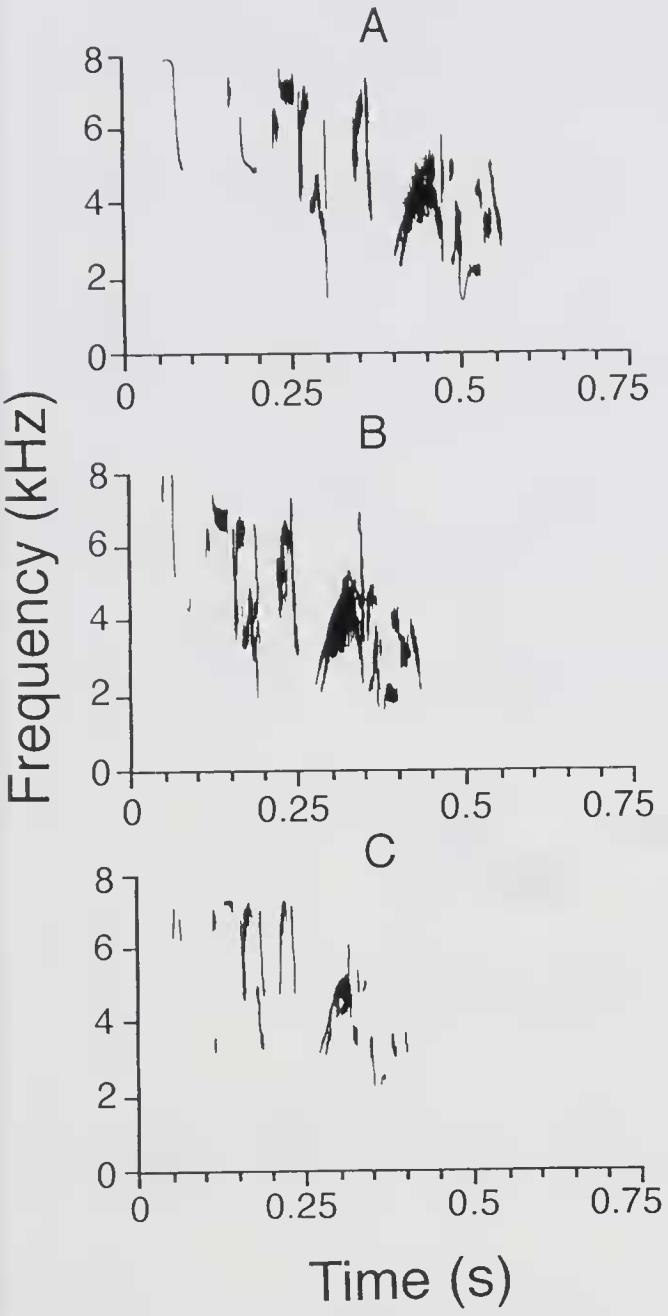

FIG. 1. Three gargle calls identified as members of the same gargle type. (A) A high-quality recording of a gargle produced in the laboratory, (B) a high-quality recording from the field, (C) a low-amplitude recording from the field.

field recordings and selected the 22 highest quality field recorded gargle calls, representing the 11 gargle groups of the Environmental Learning Center sample, and the 23 highest quality field-recorded gargle calls, representing the 10 gargle groups of the Lee Martinez Park sample, for detailed syllable-by-syllable comparison to the laboratory recordings. We each independently compared the field recorded syllables to the laboratory recorded syllables.

In these 45 comparisons, we found no gargle calls or component syllables recorded in the field that were not also recorded in the laboratory. A representative sample of three different gargle calls recorded in the field at Environmental Learning Center and their laboratory recorded matches is shown in Fig. 2. Three different gargle calls recorded in the field at Lee Martinez Park and their laboratory counterparts are shown in Fig. 3.

DISCUSSION

We conclude that Black-capped Chickadees in natural social circumstances do not display a larger variety of gargle calls than they do in the laboratory when responding to their image in a mirror. This conclusion was also reached in a previous study (Miyasato and Baker 1999) with a smaller sample of field recordings from a single location. Together these studies have examined 965 gargle calls recorded in the field in natural social circumstances and no gargle calls have been found that differ from those recorded from captive birds.

Chickadees probably draw from the same repertoire of elements in any situation eliciting gargle calling and there may be no special set of gargle calls reserved for specific contexts. It is more likely that message and meaning of gargle calling derives from the context itself (Smith 1977). Variations in the context could also be accompanied by variations in repertoire sequencing or amplitude of delivery. Even though our laboratory assay prevented vocal transactions with an opponent, and the visual stimulation unusual or infrequently encountered in nature, the repertoire expressed was made up of the same primary signal units (Smith 1991) as occur in natural social behavior. This opens the door for the investigation of how the actual performance features of gargle calling can be manipulated by varying the context of signaling in the laboratory assay.

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TABLE 1. Number of gargle calls recorded and gargle groups classified in two seasons (1996–1997, 1997–1998) in two populations (ELC: Environmental Learning Center, LMP: Lee Martinez Park) from tape recordings made in the laboratory and the field.

	1996–1997		1997–1998	
	ELC	LMP	ELC	LMP
Lab recordings				
Number of birds	10	7	9	9
Number of gargles	4985	3114	5436	8398
Number of gargle groups	24	16	12	15
Field recordings				
Number of birds	?	?	?	?
Number of gargles	109	185	225	382
Number of gargle groups	4	10	10	9

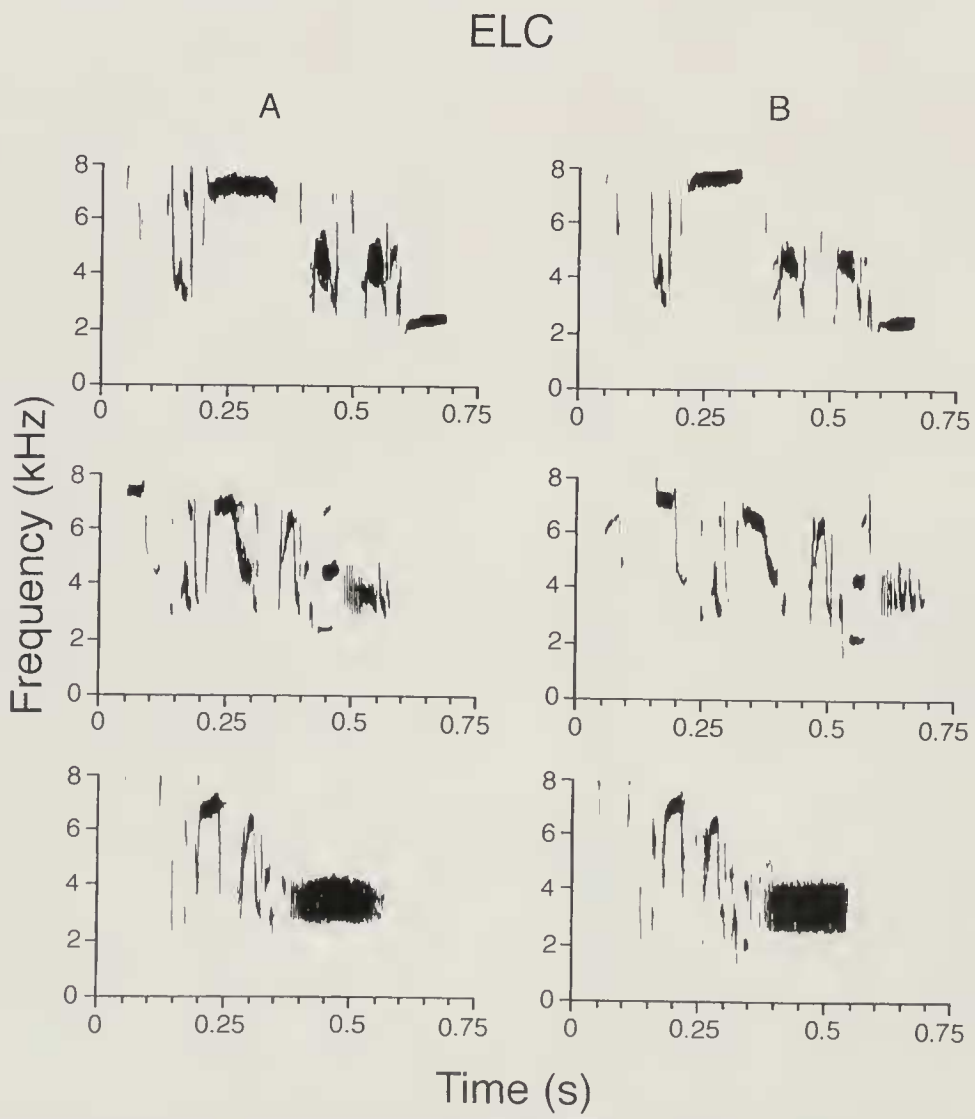

FIG. 2. Gargle calls recorded from Black-capped Chickadees from the Environmental Learning Center (ELC). (A) Calls recorded from three different birds in the field, (B) equivalent call type recorded in the laboratory.

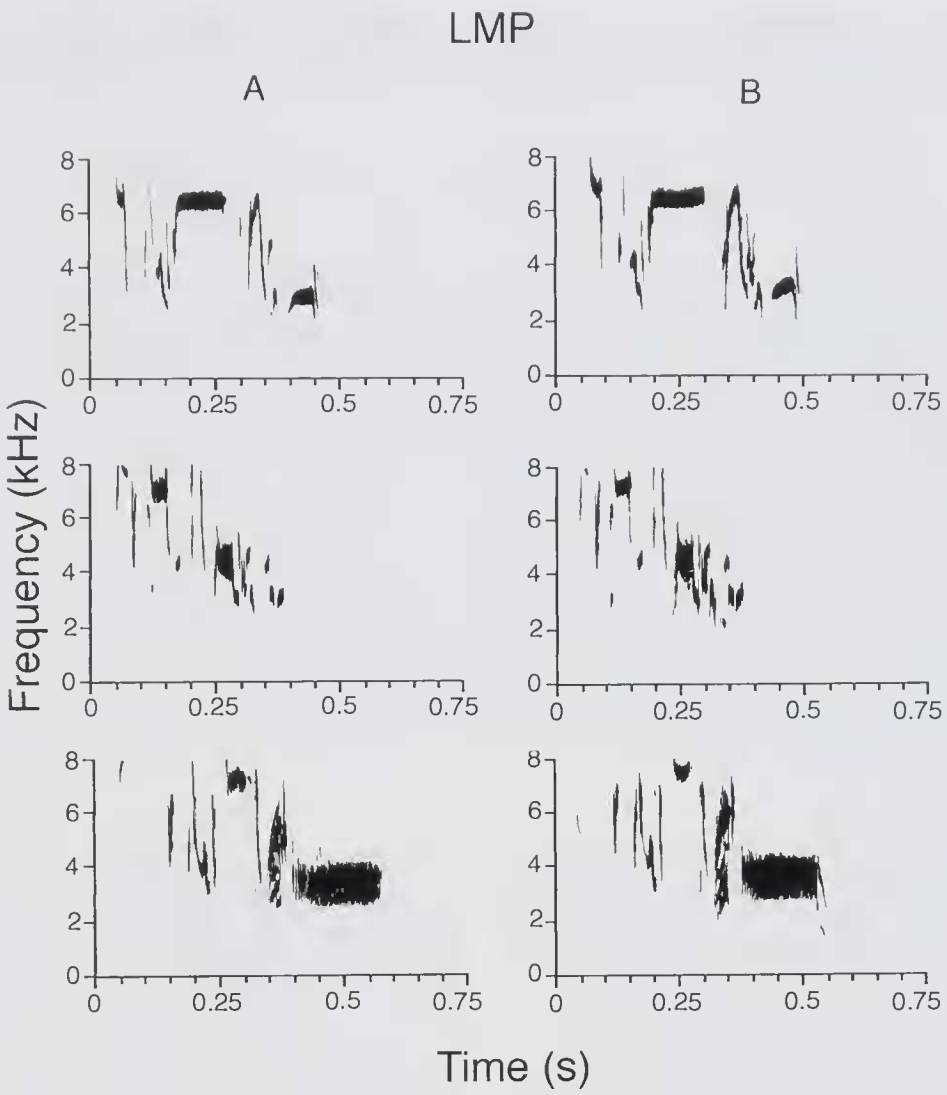

FIG. 3. Gargle calls recorded from Black-capped Chickadees from Lee Martinez Park (LMP). (A) Calls recorded from three different birds in the field, (B) equivalent call type recorded in the laboratory.

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